WE CLAIM

1. A method for forming non-circular perforations in a subterranean hydrocarbon-bearing formation surrounding a wellbore using a non-linear, shaped charge perforator, said method comprising:

(a) placing said non-linear, shaped charge perforator in said wellbore, said shaped charge perforator comprising (1) a single, axisymmetric case having a hollow interior, an open front end, side walls, and a closed back end, (2) a jet-producing, axisymmetric liner disposed within said axisymmetric case and closing said open front end and (3) a main explosive charge disposed within said hollow interior between said liner and the closed back end of said axisymmetric case, wherein said main explosive charge has a back that conforms to and is substantially flush with said closed back end, sides that conform to and are substantially flush with said side walls, and a front that conforms to and is substantially flush with said liner; and

(b) detonating said non-linear, shaped charge perforator by initiating said main explosive charge at two or more points located such that said liner is formed into a jet having a shape that enables said jet to penetrate said hydrocarbon-bearing formation in such a manner as to produce a substantially non-circular perforation in said formation.

2. The method defined by claim 1 wherein said jet, when viewed in cross section perpendicular to the plane in which the jet is broadest, comprises a fan-shape.

3. The method defined by claim 1 wherein said main explosive charge is initiated at two points on its outside surface between about 165° and about 195° apart.

4. The method defined by claim 3 wherein said points of initiation are in a single plane perpendicular to the central horizontal axis of said shaped charge perforator.

5. The method defined by claim 3 wherein said main explosive charge is initiated at two points between about 165° and about 195° apart on said back of said main explosive charge.

6. The method defined by claim 3 wherein said main explosive charge is initiated at two points between about 165° and about 195° apart on said sides of said main explosive charge.

7. The method defined by claim 6 wherein said initiation points are located on said sides near the back of said main explosive charge.

8. The method defined by claim 6 wherein said initiation points are located on said sides near the middle of said main explosive charge.

9. The method defined by claim 6 wherein said initiation points are located on said sides near the front of said main explosive charge.

10. The method defined by claim 3 wherein said axisymmetric liner comprises a shape selected from the group consisting of conical, bi-conical, tulip, hemispherical, trumpet, bell-shaped, hyperboloid, hyperbolic-paraboloid and parabolic.

11. The method defined by claim 3 wherein said axisymmetric case comprises an interior shape selected from the group consisting of conical, bi-conical, tulip, hemispherical, trumpet, bell-shaped, hyperboloid, hyperbolic-paraboloid, cylindrical and parabolic.

12. The method defined by claim 3 wherein said axisymmetric liner is substantially in the shape of a cone and the interior of said axisymmetric case is partially in the shape of a cone and partially in the shape of a cylinder.

13. The method defined by claim 3 wherein said perforations are substantially the shape of a slot.

14. The method defined by claim 13 wherein said perforations are the shape of a substantially linear slot.

15. The method defined by claim 13 wherein said slot has an aspect ratio greater than about 1.5.

16. The method defined by claim 3 wherein said main explosive charge is simultaneously initiated at said two points by separate electronic detonators.

17. The method defined by claim 3 wherein said main explosive charge is simultaneously initiated at said two points by a booster explosive that is initiated at a single point.

18. The method defined by claim 3 wherein said initiation of said main explosive charge is carried out at said two points and there is initiation at no other point.

19. The method defined by claim 1 wherein said main explosive charge is initiated simultaneously at two or more points.

20. A method for forming substantially linear perforations in a subterranean hydrocarbon-bearing formation surrounding a wellbore using a non-linear, shaped charge perforator, said method comprising:

(a) placing said non-linear, shaped charge perforator in said well bore, said shaped charge perforator comprising (1) a single case having a hollow interior, an open front end and a closed back end, (2) a jet-producing liner disposed within said case and closing said open end and (3) a main explosive charge disposed within said hollow interior between said liner and the closed back end of said case, wherein said main explosive charge has a back that conforms to and is substantially flush with said closed back end, sides that conform to and are substantially flush with said side walls, and a front that conforms to and is substantially flush with said liner; and

(b) detonating said non-linear, shaped charge perforator by initiating said main explosive charge at two points between about 165° and about 195° apart on the outside surface of said main explosive charge such that said liner is formed into a fan-shaped jet that penetrates said hydrocarbon-bearing formation in such a manner as to make a substantially linear perforation in said formation, wherein said main explosive charge is initiated at no other point.

21. The method defined by claim 20 wherein said case does not have an elliptical profile.

22. The method defined by claim 20 wherein said main explosive charge is simultaneously initiated at said

two points by a booster explosive that is initiated at a single point.

23. A non-linear shaped charge perforator comprising:

(a) a single axisymmetric case having a hollow interior defined by (1) side walls, (2) a closed back end and (3) an open front end, wherein said closed back end and/or side walls of said case contain at least two passageways communicating with said hollow interior;

(b) a jet-producing, axisymmetric liner disposed within said axisymmetric case and closing said open front end;

(c) a main explosive charge disposed within said hollow interior between said liner and the closed end of said axisymmetric case, wherein said main explosive charge has (1) a back conforming to and substantially flush with said closed back end (2) sides conforming to and substantially flush with said side walls and (3) a front conforming to and substantially flush with said liner; and

(d) a booster explosive occupying said passageways in said single axisymmetric case and communicating with the back or sides of said main explosive charge at two or more initiation points.

24. The shaped charge perforator defined by claim 23 devoid of wave shapers, deflectors, inner cases and mechanical inserts.

25. The shaped charge perforator defined by claim 23 wherein said single axisymmetric case contains two passageways filled with said booster explosive, wherein said booster explosive communicates with the back or sides of said main explosive charge at two initiation

points located between about 165° and about 195° apart on either the back or the sides of said main explosive charge.

26. A non-linear shaped charge perforator for forming perforations in subterranean hydrocarbon-bearing formations comprising:

(a) a single axisymmetric case having a hollow interior defined by (1) side walls, (2) a closed back end and (3) an open front end;

(b) a jet-producing axisymmetric liner disposed within said axisymmetric case and closing said open front end;

(c) a main explosive charge disposed within said hollow interior between said liner and the closed end of said axisymmetric case, wherein said main explosive charge has (1) a back conforming to and substantially flush with said closed back end (2) sides conforming to and substantially flush with said side walls and (3) a front conforming to and substantially flush with the said liner; and

(e) means for initiating said main explosive charge at two locations between about 165° and about 195° apart on either the back or sides of said main explosive charge, wherein said shaped charge perforator contains no means of initiating said main explosive charge at any other location.

27. The shaped charge perforator defined by claim 26 wherein said closed back end and/or side walls of said single axisymmetric case contain two passageways communicating with said hollow interior, and said means for initiating comprises a booster explosive occupying said passageways and communicating with said main explosive charge at said two initiation locations.

28. The shaped charge perforator defined by claim 27 wherein said initiation locations are both positioned on the sides of said main explosive charge and said passageways originate at one location in the rear of said closed back end of said case and pass through said back end and said side walls to said initiation locations.

29. The shaped charge perforator defined by claim 27 wherein said initiation locations are both positioned on the back of said main explosive charge and said passageways originate at two separate locations in the rear of said closed back end of said case and pass through said closed back end to said initiation locations.

30. A perforating gun comprising a plurality of the shaped charge perforators of claim 23.

31. The perforating gun defined by claim 30 wherein said shaped charge perforators are arranged in a helical fashion on the charge tube of said perforating gun.

32. A perforating gun comprising a plurality of the shaped charge perforators of claim 26.

33. The perforating gun defined by claim 32 wherein said shaped charge perforators are arranged in a helical fashion on the charge tube of said perforating gun.

34. The shaped charge perforator defined by claim 26 wherein said means for initiating comprises a detonator cord.

35. The shaped charge perforator defined by claim 26 wherein said means for initiating comprises an electronic detonator.

36. The method defined by claim 3 wherein said initiation of said main explosive charge is carried out at said two points and there is no initiation at the back of said main explosive charge on the central horizontal axis of said shaped charge perforator.